

## IMPROVED METHOD OF ASSEMBLING METAL DOORS AND METAL DOORS ASSEMBLED THEREBY

### Field of the Invention

[0001] The present invention relates to metal doors and panels.

[0002] In particular, this invention relates to improved methods to fabricate metal doors and panels, and metal doors and panels fabricated by these improved methods.

### Background of the Invention

[0003] Metal building doors are typically fabricated by joining two metal sides or skins of the door together (FIG. 1). The edges of the longer sides (stiles) of each skin (13, 23) are profiled such they mate in a complementary fashion. Examples of such profiles are shown in FIGS. 2 and 3.

[0004] Under one current technique of the art, one skin 10 of the door is temporarily fastened onto a horizontal work surface 11 (FIG. 1). Any supporting structures such as beams, or materials or fittings in the interior of the door such as sound or fire proofing materials, or even armor plates, may now be fastened onto the first skin.

[0005] The other skin 20 is then positioned at one end of the first skin. The shorter side (rail) 24 of the second skin nearest the first skin is then aligned with the rail 14 of the first skin either manually or with the aid of a hoist.

[0006] When ends of the stiles of the second skin have engaged the nearest ends of the complementary stiles of the first skin fastened to the work surface, the second skin is then moved by being pushed, pulled, or both push-and-pulled over the first skin. This may be done manually or with the help of winches and pulleys.

[0007] This is possible as the opposite sides of the skins having the profiled edges are substantially parallel to each other and to the complementary

profiled edges of the other skin of the door. The two skins are mated by moving their skins together until their complementary profiled edges are fully engaged along their entire lengths.

[0008] The lower skin is then released from the work surfaced and the door further processed. This further processing may include fastening the two skins in place by welding or the addition of conventional fasteners, capping of any exposed ends, installation of ironmongery such as locksets, handles, and hinges, and finishing the door by painting.

[0009] There are a number of problems associated with this method of assembling the two skins of these metal doors. Firstly, a great deal of effort has to be exerted to bring the two skins together as friction along the stiles increases as the length of the complementary stiles engaged increases.

[0010] Secondly, the fit of the complementary edges is usually very tight and once the two skins are engaged, even partially, it is extremely difficult to separate them for any reason, such as to realign the two skins, or to reposition the materials or fittings in the interior of the door.

[0011] Another difficulty is that the tolerance of manufacture for the complementary edges must be high for a good fit in the assembled door. This raises the cost of manufacture.

[0012] Therefore, a need clearly exists for an improved method of fabricating or assembling metal-skinned doors that overcomes the problems of the prior art.

### **Summary of the Invention**

[0013] The present invention seeks to provide, in one aspect, a method for assembling two or more skins of a metal structure, the method comprising: temporarily fastening a first skin with at least one profiled edge to a work surface;

moving a second skin with at least one profiled edge to engage the at least one profile edge with the at least one profiled edge of the first skin thereby forming at least one channel;

applying at least one locking means; and  
finishing the metal structure.

[0014] In another aspect, the present invention provides a metal structure comprising:

a first skin with at least one profiled edge substantially forming one side of the structure; and

at least one more skin with at least one profiled edge substantially forming the other side of the structure;

wherein

the at least one profiled edge of the first skin and the at least one profiled edge of the second skin form at least one channel; and a tight fit is obtained only after a locking means is applied.

### **Brief Description of the Drawings**

[0015] A preferred embodiment of the present invention will now be more fully described, by way of example, with reference to the drawings of which:

[0016] FIG. 1 illustrates a how a metal skinned door may be fabricated under a method of the prior art;

[0017] FIG. 2 is an elevational view of the complementary edges of the two skins of a metal door;

[0018] FIG. 3 is a cross-section of a metal skinned door showing how the two complementary edges mate;

[0019] FIG. 4 is shows how the two skins of one embodiment of the present invention is locked by means of locking bars;

[0020] FIG. 5A-C show cross-sectional views of the complementary edges of another embodiment the door of the present invention before and after a locking bar is inserted;

[0021] FIG. 6 shows interruptions of one complementary edge in yet another embodiment of the invention; and

[0022] FIG. 7 shows the invention applied in a non-rectangular panel.

### **Detailed Description of the Drawings**

[0023] A detailed description of the present invention will now be given in accordance with a preferred embodiment of the invention. In the following description, details are provided to describe the preferred embodiment. It shall be apparent to one skilled in the art, however, that the invention may be practiced without such details. Some of these details may not be described at length so as not to obscure the invention.

[0024] There are many advantages of the preferred embodiment of the invention. One advantage of the preferred embodiment is that less effort is needed to move the two skins of the door together under the method of the present invention. The method and product of the present also allows the two skins of the assembled door in one embodiment to be subsequently separated for any reason with less effort than using the techniques of the current art.

[0025] Another advantage of the present invention is to provide metal door skins with lower manufacturing tolerances, hence lowering manufacturing costs but without detracting from the fit, finish or overall quality of the door.

[0026] The door fabricated under the present invention can lower manufacturing cost with its ease of manufacture and assembly. Waste is also reduced as the doors thus fabricated may be disassembled easily to correct any deficiencies before delivery instead of being scrapped.

[0027] While the description that follows uses the assembly and fabrication of a metal door for a building as an example, it is contemplated that the method and product of the present invention is applicable to the assembly and fabrication of other similar structures. These structures include metal panels and metal doors for equipment, vehicles and enclosures other than buildings. Examples of these other structures include cladding panels, building partitions, access doors for heavy equipment, and the like.

[0028] Under the present invention, the two skins for a metal door are initially positioned as in the method of the prior art as shown in FIG. 1. The door skins of the present invention also mate in a complementary fashion.

[0029] However, the profiles of the door edges of the present invention differ from prior art in two aspects. The first difference is that the mating of substantially parallel and complementary edge profiles by moving the skins together do not result in a tight fit. As the two profiled edges (FIG. 4B) do not form a tight fit, much less effort is needed to move the two skins together. At this stage, the two skins may also be easily moved apart again for any reason.

[0030] The second difference is that a channel 30 is formed by the complementary profiled edges after the two skins are moved together (FIG. 4B). A locking means such as a locking bar 40 with a tapered end and a length substantially the same as the height of the finished door, is then applied (FIG. 4A). The locking bar may be applied by driving it from one end of each of these channels into the channels to lock the two skins together, resulting in the tight fit in the edge profiles of the skins (FIG. 4C). The dimensions and cross-sectional shape of the locking means and that of the profiled edges are predetermined to provide ease of assembly, and subsequent disassembly if desired.

[0031] As such, the choice of the profiled edges and the locking means determine whether the application of the locking means is reversible or not reversible, rendering the locking of the two skins either permanent or temporary as desired.

[0032] For example, in one embodiment, the profile of the channels formed by the two skins and a locking bar of known dimensions and cross-sectional shape may be selected. When the locking bar is applied, say by tapping it into a channel with a mallet, the locking bar distorts the cross-sectional shape and dimensions of the channel sufficiently to permanently lock the two skins together (FIGS. 4B and 4C). In an embodiment of the present invention, such a channel may be oval in cross-section. When a locking bar with a round cross-section of sufficient diameter is driven in, the channel will then be distorted and approximate a circle in cross-section, locking the two skins together.

[0033] Alternatively, in another embodiment, the channel initially formed by the two skins may be rectangular in cross-section and locking means may be a bar with a round cross-section of a predetermined diameter (FIGs. 4B and 4C). The diameter of the locking bar may be selected such that when driven in, the locking bar forms an interference or press fit with the channel. Such a locking bar may be readily applied or removed subsequently to disassemble the door should such a need arise.

[0034] In yet another embodiment, the channel formed by the two profiled edges of the may be interrupted instead of being continuous along its length (FIG. 6). After a locking means has been driven in, the total area of contact between the channel and the locking means is less than that for a continuous channel. As such, it will be easier to remove the locking means by driving it out should the need to disassemble the door arise.

[0035] In another embodiment, the locking means may be two locking bars, substantially shorter than the length of the door, driven in at either end of the channels formed by the two skins of the door. Other locking means such as wedges may also be used. Again, such doors may be subsequently disassembled by removal of the locking means used.

[0036] In yet another embodiment, the profiled edges of the two skins of a metal door comprise complementary engagement members of a tab 50 and a slot 60 that do not engage each other before the locking means is driven in (FIG. 5).

[0037] A locking means such as a locking bar 40 is then driven into the channels formed by the profiled edges of the skins. As the bar is driven in, the complementary engagement members comprising tabs 50 and slots 60, found at intervals along the complementary edges of the respective skins, will be progressively pushed by the locking bar into engagement. Although a locking bar with a flat cut end may be used, a domed or pointed end as shown in FIG. 5 will facilitate the driving in of the locking bar into the channel. This embodiment of the present invention provides for a permanent locking of the door skins when disassembly of the skins is not required.

[0038] A person skilled in the art will appreciate by looking at the cross-section of the edge profiles in FIG. 5C that the skins of doors or panels of this embodiment need not be slid together to mate as with doors of the prior art and the other embodiments of the present invention. They may simply be laid one over the other.

[0039] This embodiment allows non-rectangular doors and panels to be assembled and fabricated. In FIG. 7, a panel with a trapezoid cross-section may be fabricated by simply laying one skin over another, ensuring that the two skins are aligned and then locking them together with two locking bars. As may be seen from FIG. 7, the complementary edge profiles need not be parallel as the skins need not be slid together.

[0040] Such skins may simply be aligned and positioned by lowering a second skin over a first skin temporarily fastened over a work surface. Proper alignment of the two skins may be ensured by verifying the positions of suitable indexing holes or marks.

[0041] A person skilled in the art will appreciate that once the complementary engagement members of the skins are engaged, the skins remain locked even if the locking bar 40 is removed as the locking tabs 50 would have engaged the slots 60 (FIG. 5). This embodiment teaches a method that permanently locks the door skins together.

[0042] A person skilled in the art will also appreciate that this embodiment of the present invention allows non-rectangular doors or panels to be assembled and fabricated as the two skins of the door or panel need not be moved by sliding one skin over the other. The complementary engagement members of the profiled edges in this embodiment allow the two skins, essentially mirror images of each other, to be placed together without the need to slide them together. As such, doors or panels having a non-rectangular (eg trapezoid cross-section as shown in FIG. 7) may be fabricated under the present invention.

[0043] Once a metal door has been assembled by the method of the present invention, it may be finished by any additional steps, like that of the prior art. These additional steps, some of which are optional, comprise

welding the door, application of fasteners, installation of ironmongery items, capping of exposed ends and painting the door. However with the self-locking features of the present invention, the amount of welding or additional fasteners is substantially reduced or even obviated.

[0044] A person skilled in the art will appreciate that conventional manufacturing methods may be readily adapted to manufacture the door skins of the present invention. Sheet metal of the desired thickness and shape are first fabricated. If the embodiment employing locking tabs and slots are desired, then these tabs and slots may be punched out along the edges of the metal sheets using a press and die after being aligned by a jig.

[0045] Thereafter the skins of the present invention with the desired profiled edges may be obtained by folding the edges of the metal sheets by the use of presses, jigs and guides. These skins may then be assembled according to the methods of the present invention as described above.

[0046] A person skilled in the art will appreciate that the present invention provides a novel and inventive method that uses locking means driven into the channels formed by the two skins of a metal door to lock the two skins together. The channels are formed by novel and inventive edge profiles of the skins of the metal doors.

[0047] By selecting the profiled edges of the skins, and the locking means to be used, the locking of the channels may be temporary or permanent. The profiled edges of the skins may also be continuous or interrupted (FIG. 6) under the scope of the present invention.

[0048] A person skilled in the art will also appreciate that while the stiles or longer sides of the skins are profiled to form the channels (FIG 4A), the rails or shorter sides of the metal door may also be fabricated into profiled edges. In such an embodiment, the skins of the door are simply placed "side by side" instead of "top to bottom", and then slid into position.

[0049] The present invention also provides an embodiment that is formed by placing or lowering, instead of sliding, one skin over another (FIG. 7). This may be achieved by the profiled edges 70 and 80 shown in FIG. 5.



[0050] While the fabrication or assembly of a metal door with two skins has been described, it is contemplated that any number of skins may also be used to form the door under the present invention. For example, one side of the door may be comprised of one skin but the other side of the door may be comprised of two or more skins.

[0051] In addition, while the present invention has described the assembly of whole metal door skins, the present invention also covers door skins that have cut outs made in them. These cut outs may be subsequently be covered by panels made of other materials for various purposes such as for viewing or decorative panels. While building doors have been described, the present invention is also applicable to the fabrication or assembly of panels and partitions, and in doors of machinery and structures other than buildings, under the scope of the present invention.

[0052] While metal doors have been described, it will be appreciated that other suitable materials, such as composites, may also be fabricated or assembled under the present invention.

[0053] A person skilled in the art will appreciate that the method of the present invention, and the various embodiments of the present invention, solve, or at least alleviate, the problems of the prior art.

[0054] It will be appreciated that although a few embodiments have been described in detail, various modifications and improvements can be made by a person skilled in the art without departing from the scope of the present invention.